Performance Comparison of Rerouting Schemes of Multi Protocol Label Switching Network.

Dr. Yogesh P Kosta [1], Minesh P Thaker [1],Bhaumik Nagar [2]
[1] VTP Dept of E&C Engg, Charotar Institute of Technology-Changa Gujarat, India
Email: mineshthaker.ec@ecchanga.ac.in ypkosta@yahoo.com
[2] IT Centre, National Institute of Design, Paldi ,Ahmedabad, Gujarat, India
Email : bhaumik_n@nid.edu

***Abstract*—In this paper, we attempt to present a comparison through rigorous studies (existing conventional models) following software based modeling and verifications through simulations in terms of various traffic parameters such as packet loss, Recovery Time (Latency), reordering of packets including recovery time for various widely used path recovery models for the purpose of end-to-end recovery of LSPs in MPLS domains using NS2 simulator.**

***Index Terms*—MPLS .path -recovery, software modeling and simulations ,traffic engineering, LSP (Label Switch Path), end-to-end delay, recovery time.**

I.INTRODUCTION

Traffic engineering is basically the process of optimizing the network(s) to maximize its overall performance [10] that ultimately leads to improved efficiency. Multi Protocol Label Switching (MPLS) being one such technology for increasing the efficacy. This technology of forwarding data packets (of a fixed size labels) is based upon a pre-determined path that the data packet needs to traverse, where thencoming packet labels are examined to determine the next hop (or the next part of the journey), the old label is then replaced with a new one (label) and once again it is forwarded to the next hop, and the journey continues till it reaches its destination.

The rest of this paper is organized as follows. Under section 2, we briefly describe various path recovery models that we have evaluated. Under section 3, we discuss the important issues relating to previous studies on the subject and explaining our work. Section 4 presents the Simulation environment used for evaluation of the said protocols. Section 5 helps consolidate our simulation results and our specific observation. Finally, section 6 concludes the paper.

II. MPLS PATH RECOVERY AND REPAIRING MODELS

In this section we have briefly described the path recovery schemes that we investigated. A detailed discussion and comparison of path recovery schemes are availed at [1].

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A. MAKAM's Models (Global Path Repairing)

One of the first proposed models for MPLS recovery was presented by Makam in the draft [2].The model provides end- to-end protection for a LSP by setting up aglobal recovery path between the ingress and egress LSR.

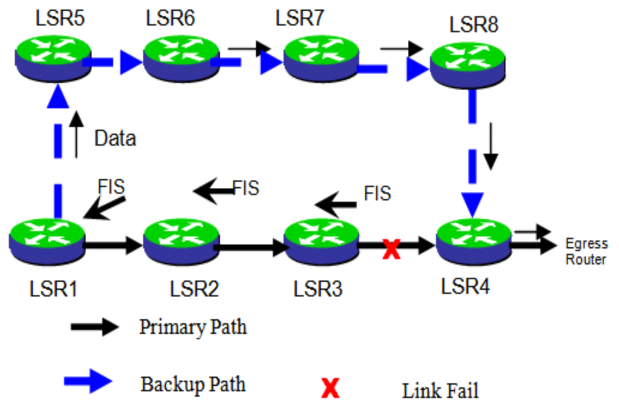

Figure 1 Makam's Model

B . HASKIN's Model(Global Path repair with RNT)

This scheme was introduced by Haskin in the draft [2] and When global recovery is used as in Makam's model, the PSL has to be informed about a failure in the working path before traffic can be switched over to the recovery path.

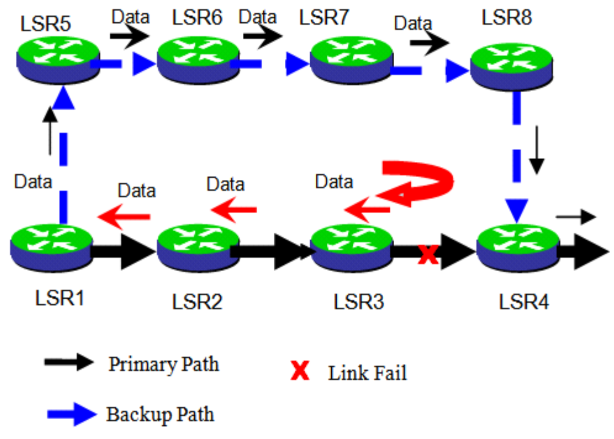

Figure 2 : Haskin's Model

A different concern for Haskin's model is the less efficient use of resources, as the total length of the recovery path gets longer than the original working path.

C. Fast Reroute Model

As shown in the fig 3 The fast reroute [4],[5],[6] shall be used end-to-end then recovery paths needs to be pre-setup

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for each link or node in the working path. This is one-to-one backup model without merging for local path protection. In this technique switch over time can be increased but more resources are required.

D. Fast reroute one-to-one backup Model (Local Repair)

As shown in fig 4 the fast reroute [7],[8] one-to-one technique a separate backup LSP, called a detour LSP is computed for each LSR in a protected path. These detour LSPs are set up to use node recovery if possible otherwise link recovery. To fully protect an LSP that traverses N nodes, there could be as many as N-1 detours.

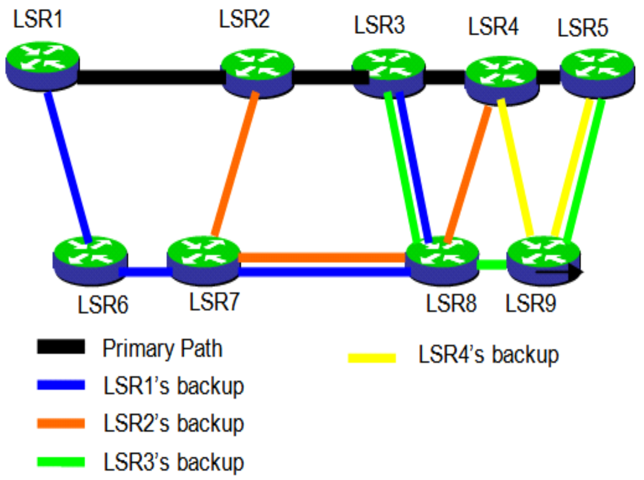

Figure 3 : Fast Reroute (one-to-one) (Local Repair)

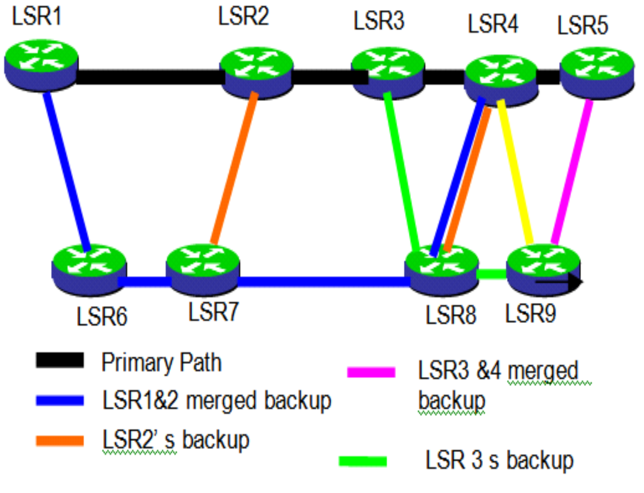

Figure 4 : Fast Reroute one-to-one with merging

III. Previous Work

In this section we analyze the most relevant previous studies concerning. Path recovery schemes for MPLS network performance comparisons. Most of the previous work is limited on performing simulations for MPLS networks with Packet loss and end-to-end delay.In this paper, we observed and commented on the behavior of each path repairing schemes.

IV. Simulation Environment

We have used network simulator ns2 for simulation, most widely used network simulator and freely downloadable. In order to compare the results we use CBR traffic flow and a UDP agent with the following characteristics: packet size = 1500 bits, source rate= 512Kbps, burst time=0 and idle time =0, Tprop = 10msec, and BW(lsp)=BW(back)= BW(alt) = 10Mbps..

V. Simulation results and observation

A. . Packet Loss:

The graph in figure 5 shows the number of dropped packets for the different models and depending on which link that breaks. In both Haskins model and the fast reroute model, traffic is switched onto a pre-setup backup path by the LSR that detects the failure, so for both of those models the only packets that are dropped are the ones dropped during the failure detection time.

For Makam's and the best effort model, the number of dropped packages increases the further away from the ingress LSR the failure occurs. This is because the FIS has to be sent back to the ingress before traffic can be switched to the backup path. In Makam's model the number of dropped packages is the same as for Haskin and fast reroute only if the failure occurs on the link out from the ingress, this is because in this case no FIS has to be sent before traffic can be forwarded on the backup path. For the best effort model, the number of dropped packages is large because packages are dropped during the failure detection time, the time for the FIS to be sent to the ingress router.

B.Full Restoration Time

The graph in fig 6 shows the Full Restoration Time, measured from the last packet that was sent over the link before it breaks is received by node 10, until the first packet that is using the backup path is received by this node. The time for Haskin's and Makam's models are the same, this time is larger than fast reroute in all cases where the failure occurs on a different link then on the ingress node. The time increases for these models the further away from the ingress node the failure occurs, this is because the FIS or reversed traffic has to be sent upstream to the ingress before it can be switched over on the global recovery path. For the best effort model, the Full Restoration time is further increased by the time to calculate and setup the backup path. For the reroute model the Full Restoration time decreases the closer to the egress LSR the failure occurs. This is partly because the closer to the egress the failure occurs, the shorter the new setup backup path can be.

C. Pre-reserved backup resources

The chart in figure 7 shows the number of resources reserved for backup traffic in the network before the failure occurs. Both the best effort and rerouting model setup the backup path on demand after the failure has occurred, and therefore no backup resources are reserved before the failure in those models. Makam's models holds five

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resources reserved for the global backup path. Haskin'smodel holds five resources for the global backup path and three for the reversed path, a total of eight. The fast reroute holds eight resources reserved for the backup path.

*D. Packets Disordered***:**

Figure 8 presents the packet disorder result for the these schemes. Note that the packet disorder that we consider here is the disorder produced during the restoration period which does not include the disorder produced by the retransmission of lost packets by a high level protocol (i.e., TCP).Makam's and other schemes do not introduce more packet disorder but cause more packet losses. It is evident from the figure that Fast reroute and Fast reroute 1to1 has low packet disorder than Haskin.

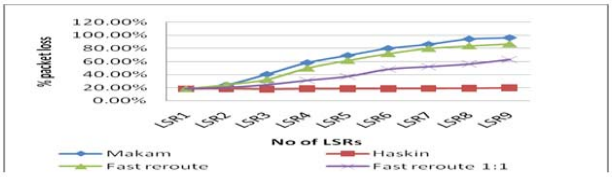


Figure 5 %packet loss by increasing LSRS

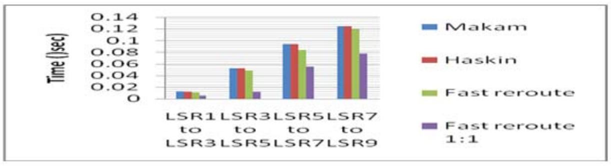
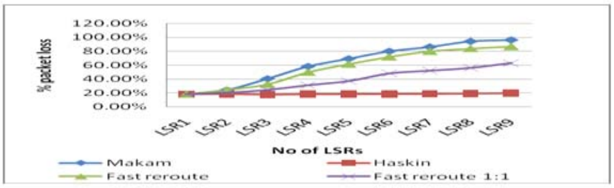


Figure 6 Full restoration Time



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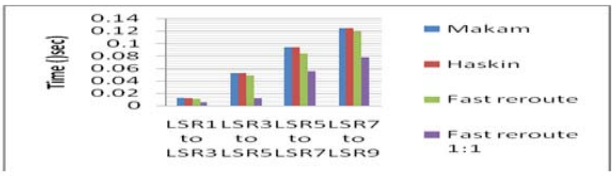

Figure 6 Full restoration Time

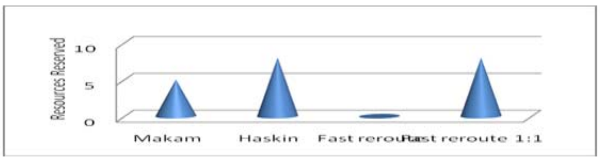

Figure 9 Topology used for simulationVI. Conclusion

Having compared the performance of above four rerouting techniques Haskin model has got fast path recovery than Makams's model. But uses more resources ,also Haskin has low packet loss ratio, less number of disordered packets than Mkam's model. As far as two Fast reroute with one-to-one techniques are concerned Fast reroute without merging was much faster as far as restoration time is concerned with respect to Fat reroute with merging. But as far as resources utilizations are concerned Fast reroute with merging uses less resources than Fast reroute without merging.
If we compare global Path repair and Local Path Repair techniques the local path repair is good at fast rerouting where as Global path is poor at fast rerouting or at full restoration time.Similarly As far as Packet disordering is concern Haskin is very good .

VII. Future work

In this simulation study, we have not used large no of nodes and simulation time was 100s. Increasing both or either of them will increase computational time which was limited due to various reasons. Thus, in future we will try to carry out more vigorous simulation so as to gain better understanding of such networks and subsequently helps in development of new protocols or modification in existing protocols.

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